to a right conception of a species; and this Dr. Dreyer has not given. He gives admirable drawings and descriptions of a great number of form-varieties, but he does not tell us how often each variety occurred in the 25,000 specimens examined. A table, showing the frequency with which every variety drawn was actually observed, would have added so greatly to the value of the work that it would have been well worth the labour involved in making it.

The essay is apparently published in the hope of stimulating others to undertake an experimental investigation of some of the factors which determine the shapes of rhizopod shells; and the author seems to have undertaken his study of *Peneroplis* as a preparation for experimental work of the same kind. Every reader will wish Dr. Dreyer a full measure of success in the difficult task he has set himself to accomplish.

For the reason just given, little attempt is made to use the observations recorded as a basis for generalisation; but the last chapter contains certain criticisms of current biological doctrines, which seem based upon fundamental misconceptions. It is difficult to convey an exact idea of a writer's meaning by quoting short extracts, but the following passages express Dr. Dreyer's position fairly well. In discussing the conception of animal evolution he says:

> "Gesetzt aber auch, die genealogische Entwicklung im ganzen oder in diesem oder jenern ihrer Zweige befände sich vollständig und sicher in unserem intellektuellen Besitz, so hätten wir hiermit eine Entwicklung, die wir naturgesetzlich eben so wenig verständen, wie die einzelnen Lebensformen, aus denen sie sich zusammensetzt."

It is, of course, perfectly conceivable that we might know the exact genealogy of all living species, or of some of them, without knowing anything of the process by which the modifications undergone by the ancestral species has been effected; but the statement that species are susceptible of modification in the course of generations, if it is true, is itself the statement of a natural law; so that Dr. Dreyer's meaning is difficult to discover.

Darwin's hypothesis concerning the process by which specific modification has been effected is dealt with as follows:

> "Nun ist die Selektionslehre einmal falsch, denn sie steht in krassem Widerspruche zur Wahrscheinlichkeitsrechnung, und wenn sie richtig wäre, würde sie ein Verständniss der uns als leibhaftige Probleme entgegentretende Organismen im nichts berühren, ebensowenig wie . . . diese oder jene Äste eines Baumes damit 'erklärt' sein können, dass sie der Gärtner nicht weggeschnitten hat.
>
> "Wenn also die Ergebnisse der Descendenz forschung problematisch sind und, wenn sie sicher wären, oberflächlich, so ist die Selektionslehre in sich hinfällig, und wenn sie richtig wäre, wäre sie nichtig.
>
> "Es wird nunmehr Zeit dass die jung aufwachsene Biologie von dieser ihrer englischen Krankheit erhole und mannbar werde."

It would be interesting to have a more detailed exposition of the author's reasons for saying that the theory of Natural Selection is in contradiction to the laws of Probability. No case has yet been described in which the phenomena of variation and inheritance have been shown not to obey the law of Probability. If Dr. Dreyer knows of such a case, he would do well to publish his knowledge.

The remainder of the criticism is worth serious notice, in spite of the bad taste shown in the last paragraph, because the objection to the use which is often made of the theory of Natural Selection is perfectly just. It is quite true that a plausible hypothesis about the utility of an organ or of a function is not a proof that it has been produced by natural selection; and when such a phenomenon as Death itself is "explained" by ingenious guess-work of this kind, one feels that much must be forgiven to a hostile critic. But these things are no essential part of the Darwinian theory. Darwin laid down two fundamental propositions—*first*, that the differences in structure between individual animals of the same race or species are associated with differences in the death-rate and power of producing offspring, so that the number of descendants left by an individual is a function of its structure; and, *secondly*, that the effect of differential fertility, associated with structural differences, is often sufficient to change the character of the race or species in the course of successive generations.

These are essentially physiological propositions, which admit of direct experimental verification or disproof. The experimental testing of these two propositions would open up a fascinating field of knowledge, which has been left almost untouched since Darwin himself wrote.

Darwin was so fully occupied in forcing men to recognise the broad fact of structural variation, that he had little time to demonstrate the relation between variation and death-rate. Nevertheless, naturalists have been content for forty years to rest a great generalisation on his work alone, without themselves attempting to amplify it by direct observation and experiment. It is time that a systematic study should be made of the relation between structural abnormality and death-rate, under definitely determined conditions of environment, in a large number of species. If the relation postulated by Darwin generally exists (as the writer believes), it is time that it should be properly demonstrated. If it does not exist, it is time that the belief in natural selection should be given up.

But it is the business of naturalists to formulate the processes of nature as well as they can; and whether the process of Natural Selection interests Dr. Dreyer or not, we ought to want to know certainly whether it occurs. The statement that such a process does affect animals generally, is either a natural law of great importance, or it is untrue. If it is true, it is as absurd to call it "nichtig" because it does not formulate *all* the processes of a living organism, as it would be to call it useless because it does not enable one to foretell to-morrow's weather.

W. F. R. WELDON.

OUR BOOK SHELF.

Elements of Sanitary Engineering. By Mansfield Merriman, Professor of Civil Engineering in Lehigh University. Pp. 216. (New York and London: Chapman and Hall, 1898.)

THE author of this book deals with the whole range of sanitary science, including an historical notice of sanitation from the time of the Israelites in Egypt; the classification of diseases; statistics of mortality as

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affected by sanitation; bacteriology; the effect of filth, impure drinking water and foul air on health; water supply, storage and filtration; construction of reservoirs and supply of water to towns; sewerage, both for cities and houses; and the disposal of garbage and town refuse. In the introductory chapter the elements of sanitary science which are essential to sanitary engineering are briefly outlined, and in the historical notes it is shown how the filthy habits of the people in early times led to direful epidemics of plague. It is pointed out that "the teachings and practice of the Christian Church during the Middle Ages regarded cleanliness as one of the luxuries which was inconsistent with godliness, while bodily filth was considered as a work of inward piety and holy sanctification. The example set by the monastic orders was imitated by the people at large; bathing was unknown, houses and clothing were filthy, and the streets served as receptacles for garbage and human excreta." Some interesting statistics are given to show how the death rate has decreased as sanitary science has advanced. The annual death rate of the population of London in the latter half of the seventeenth century was nearly 80 per thousand; in the eighteenth century, about 50 per thousand; and soon after the middle of the nineteenth century, about 24 per thousand; and now ranges about 20·5 per thousand. An efficient system of sewerage and water supply has been known to reduce the death rate in large towns in England and the continent from typhoid, from a rate of 2·2 per thousand inhabitants to 0·4 per thousand. The cholera epidemic which visited Hamburg in 1892, caused 8976 deaths, being at the rate of 134 per thousand in Hamburg, where the water supply was proved to be impure and to contain the cholera bacillus; while in Altona and Wandsbeck, adjoining the city, where the water was properly filtered before being supplied, the rate was respectively 23 and 22 per thousand.

This book, which is written for American students of sanitation, does not contain anything that is not known to sanitary engineers of this country. Naturally, in such a small compass it was not practicable to deal with any of the subjects treated in an exhaustive manner; nor can the work be regarded as a textbook, but rather as a well-written and able digest of matters which come within the range of the sanitary engineer.

La Cytologie Expérimentale. By A. Labbé. Pp. viii + 187. (Paris: Carré, 1898.)

THIS neat little book has the attractive form and style which characterises many French science manuals, and shares with them the defects inherent in any attempt to convey the difficult results of refined biological research in short paragraphs, even when written in the clearest of languages. At the same time we must add that it does not profess to be a complete text-book or treatise on the subject, and it is perhaps best described as a series of notes on some modern results of the study of the cell, by a zoologist. Artificial protoplasm and artificial karyokinetic figures are misleading terms to the beginner, and the scraps of information here gathered can be of little or no use to more advanced readers. The action of physical and chemical agents on the structure, metabolism, and movements of the cell seems curiously incomplete, in a French work, without reference to the yeast-plant; and although the notes on chemotaxis are interesting, they might have been rendered more valuable had the botanical side of the question been more fully dealt with. Indeed, throughout the work we notice a lack of appreciation of the work of plant-physiologists, *e.g.* as regards geotropic and heliotropic curvatures—no doubt inevitable where the author is a zoologist, the domain of each subject being now so wide that no one writer can deal adequately with both. Klebs' work on the effects of the environment in modifying the reproduction of algæ, for instance, is not mentioned.

The reciprocity between nucleus and cytoplasm; experimental modifications of cellular reproduction; adaptation to the environment; "tropisms and tactisms"; and cellular differentiation, are the other subjects dealt with.

While finding fault to the extent we have done, it is only fair to add that the subject-matter, so far as it is treated, is fascinating from every point of view, and many of the facts given are extremely interesting—*e.g.* those concerning the artificial separation of the nucleus from animal ova, those on "*cyto-symbiose*" and adaptation to parasitic life, those on intercellular connections, &c. Much more ought to have been said, we think, concerning the discoveries of botanists, especially in connection with the last two subjects.

The illustrations are numerous, well executed, and to the point; and praise must be accorded the glossary and the index to the bibliography, so far as it goes. Finally, we welcome this little book of notes, in the hope that it will be the forerunner of a more masterly treatise on an important and fascinating subject.

Studien über Hirsche (Gattung Cervus *im weitesten Sinne).* Heft I. Untersuchungen über mehrstangige Geweihe und die Morphologie der Hufthierhörner im Allgemeinen. By Dr. H. Nitsche. Pp. xi + 102. Plates xii. (Leipzig: W. Engelmann, 1898.)

WHETHER the work of which this first instalment is before us is intended to be a monograph of the *Cervidae*, or whether it is to be restricted to morphological considerations, future parts will decide. The present section deals solely with the morphology of antlers and their relations to the horns of other ruminants. In discussing antlers, most English zoologists of recognised position have confined their attention to normal examples. Not so Dr. Nitsche, who is apparently of opinion that the clue to the homology of the diverse structure of these appendages in different species is to be found in abnormalities, especially such as display a double or triple beam. Such abnormalities are classed under four types, in three of which the additional antler is more or less like the original form, while in the fourth the additional and normal portion together resemble an ordinary antler. Whether the result of these studies will have any important bearing on the classification of the *Cervidae*, cannot well be considered till the appearance of the later parts.

In the meanwhile attention may be directed to the author's very lucid account of the distinctions between the cranial appendages of the Pecora; such distinctions being admirably illustrated in Plate xii. To put it shortly, the author, in opposition to the view of M. Lataste, regards antlers as true outgrowths, or apophyses, from the frontal bones; these processes are at first covered with hairy integument, after the shrivelling-up and removal of which the exposed bare portion eventually falls off from necrosis at the base. In the following year the whole process of growth and shedding is repeated. On the other hand, in the remaining three families of the Pecora, to wit, *Giraffidae*, *Antilocapridae*, and *Bovidae*, the appendages originate as independent bony epiphyses, which become subsequently welded to the frontals. In the giraffe the horns, as these appendages should be called in all the members of the group, are clothed only with hairy skin. In the prongbuck a deciduous and forked horny sheath is superadded to the hairy skin. On the other hand, in the *Bovidae*, the hairy skin is lost, and the bony core is covered simply with a non-branched and non-deciduous horny sheath. The epiphysial origin of the horn-cores of the *Bovidae* is illustrated by a figure of the frontal region of a young chamois.

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